DiFX 1.5.x RFI Mitigation
Project Documentation

Version: June 30, 2010

Draft

<u>Start date:</u> The project started April 2010.

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Project goal

Replace the simple baseline data time integration in mainline DiFX 1.5 with baseline data low-pass filtering, using a multirate multi-stage filtering approach to achieve sub-Hertz cutoff frequencies. The cutoff frequencies should be configurable per baseline to keep data up to the fringe frequency and filter out higher frequency data which is due to correlated RFI.

Acronyms

RFI   Radio-frequency interference

DiFX   ATNF CSIRO Swinburne software FX-correlator

Reference material

See DiFX 1.5.3 SVN, 'doc' directory (todo).

Contents

Output of work

The project has the following deliverables:

Done	Title	Assigned	Week

Changes to the DiFX Interface

Support for RFI mitigation via baseline filtering requires a small number of modifications to the base DiFX. Current work is based on DiFX 1.5.3 64-bit. The configuration file format for DiFX 2.0 and 2.5 is going to change "significantly" according to A. Deller, however without much improvement in terms of easy usability and extensibility. Hence the filter coefficients necessary for baseline filtering are now stored in a separate *.coeff* file, with the file name and path indicated by one new configuration file setting. This *.coeff* file must be visible with the same path name to all nodes in the cluster.

The configuration file now recognizes the following new keywords within the example context below:

```
VIS BUFFER LENGTH    16000000
OUTPUT FORMAT DIFX
OUTPUT FILENAME      /mnt/io01/expt/e0001/difx/output
BLINE FLT TYPE       IIR_SOS
BLINE FLT COEFFS     /mnt/io01/expt/e0001/config/baselinefilter.coeff
```

The mapping of configuration file and Configuration class members is:

BLINE FLT TYPE	baselinefltformat	getBaselineFLTFormat()
BLINE FLT COEFFS	baselinefltfilename	getBaselineFLTFilename()

The entry for filter type in the configuration file accepts the following choices:

Setting of BLINE FLT TYPE	Meaning
NONE	Baseline RFI filtering is disabled
FIR	Use finite impulse response filter
IIR_SOS	Use infinite impulse response filter, composed of second-order structures

The format if the *.coeff* file depends in the type of filter selected. Several chained filters can be added into the same coefficient file. The number of filters and the sampling rate decimation factors at the input of each filter are specified in the coefficient file.

Setting of BLINE FLT TYPE	Format of .coeff file
NONE	File is ignored
FIR	```# Comment line(s)` `3 # the number of filters in series` ` ` `# Filter 1` `16 # decimation ratio before filtering` `32 # FIR filter order N` `-1 1 0.5 1.5 …. # filter coefficients (N+1)` ` ` `# Filter 2` `128 # decimation ratio before filtering` `16 # FIR filter order N```

| | ```
-1 1 0.5 1.5 …. # filter coefficients (N+1)

# Filter 3
128  # decimation ratio before filtering
16   # FIR filter order N
-1 1 0.5 1.5 …. # filter coefficients (N+1)
``` |
| IIR_SOS | ```
# Comment line(s)
3   # the number of filters in series

# IIR Filter 1
16   # decimation ratio before filtering
2    # IIR SOS filter, number of sections (M)
# filter coefficients in M rows (M x 6 coeffs total)
# b0(1) b1(1) b2(1) a0(1) a1(1) a2(1)
# …
# b0(M) b1(M) b2(M) a0(M) a1(M) a2(M)
1 0.3 0.4 1 0.1 0.2
1 0.3 0.4 1 0.1 0.2

# IIR Filter 2
16
2
1 0.3 0.4 1 0.1 0.2
1 0.3 0.4 1 0.1 0.2


# IIR Filter 3
16
3
1 0.3 0.4 1 0.1 0.2
1 0.3 0.4 1 0.1 0.2
1 0.3 0.4 1 0.1 0.2
``` |

Matlab tool for deriving filter coefficients

TODO: document

Verification with test data

TODO: document

Verification with EVN data

TODO: document